April 28, 2009

Honorable Lisa P. Jackson, Administrator
United States Environmental Protection Agency
Ariel Rios Building
1200 Pennsylvania Avenue, NW
Mail Code 1101A
Washington, DC 20460

By Facsimile & U.S. Mail

Re: Petition for Rulemaking to Update the Regulation of Sewage Discharges from Large Vessels (Section 312 of the Clean Water Act)

Dear Administrator Jackson:

In passing the Clean Water Act ("CWA") Congress made its overriding goal clear: to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters."[1] There can be little doubt that the CWA has been the primary factor in achieving dramatic improvements in the water quality of our Nation's waterways, even as our economy and population have increased. However, we are still far from having achieved Congress' stated goal, and there remain areas in which the U.S. Environmental Protection Agency ("EPA") must do more to protect the Nation's waters. This Petition addresses one such area.

Large vessels continue to discharge significant volumes of pollution and sewage into our coastal waters. Cruise ships, for example, have the potential to generate and discharge as much waste as a small town while operating in sensitive ecosystems.[2] In section 312 of the CWA, Congress specifically recognized the importance of controlling the discharge of sewage from vessels. In promulgating vessel discharge regulations, EPA is required to design standards within the limits of available technology that prevent the discharge of untreated or inadequately treated sewage in to navigable waters.[3] More than thirty years have passed since EPA first promulgated vessel sewage discharge regulations and EPA has not updated the standards to reflect the dramatic technological advances that have been made in treatment technology in the past thirty years.[4] EPA acknowledged, almost nine years ago, that the applicable standards for vessel sewage discharges were "developed in 1976 and may no longer be sufficiently stringent in light of available new technologies."[5] EPA has an obligation, in order to meet the Congressionally stated goals of the CWA, to amend these standards to reflect the significant technological advances that have been achieved.

---

[1] 33 U.S.C. § 1251(a).
[2] U.S. Environmental Protection Agency, Cruise Ship Discharge Assessment Report 1-1 (2008) [hereinafter "EPA 2008 Cruise Ship Assessment"].
[3] 33 U.S.C. § 1322(b)(1).
[4] *See* 40 C.F.R. § 140.
[5] U.S. Environmental Protection Agency, Cruise Ships White Paper 13 (2000).

Pursuant to the Right to Petition Government Clause in the First Amendment of the United States Constitution, section 553(e) of the Administrative Procedure Act,[6] and section 312 of the Clean Water Act,[7] Friends of the Earth[8] hereby petitions the EPA to update the vessel sewage discharge standards promulgated under section 312 of the Clean Water Act and contained in 40 C.F.R. § 140. Specifically, Friends of the Earth files this Petition for Rulemaking and Collateral Relief with the Administrator and respectfully requests her to undertake the following actions:

1) Issue standards under section 312 of the Clean Water Act updating the vessel sewage discharge performance standards found in 40 C.F.R. § 140 for Type II Marine Sanitation Devices;

2) Create strong monitoring, recordkeeping, and reporting requirements under section 312 to ensure compliance with vessel discharge performance standards.

I. Facts & Background

A. Sewage & Large Vessels

Applicable regulations promulgated under the CWA define sewage as "human body wastes and the wastes from toilets and other receptacles intended to receive or retain body wastes."[9] Sewage from vessels is more concentrated than domestic sewage because vessels tend to use a smaller volume of water for sanitary purposes than is typical on land.[10] The discharge of sewage from vessels into the waters of the United States, and particularly discharges into coastal ecosystems, contributes to the degradation of the marine environment by introducing disease-causing microorganisms and excessive nutrients.[11]

People eating fish or engaged in water sports or swimming in coastal environments can contract illnesses (including gastrointestinal illnesses, diarrhea, ear nose and throat illnesses, vomiting, hepatitis, and respiratory diseases)[12] from contact with fecal-contaminated waters. While most sewage-caused illnesses are acute, some are potentially life-threatening.[13] A recent Joint Group of Experts on the Scientific Aspects of Marine Environmental Protections study found that the occurrence of these infections and diseases rises steadily with increasing sewage contamination; and even minimal amounts of contaminated water puts users such as swimmers at an elevated risk for infection.[14] Sewage discharges, from both land and sea, contribute directly

---

[6] 5 U.S.C. § 551, *et seq.*

[7] 33 U.S.C. § 1322.

[8] Friends of the Earth is a public interest, non-profit advocacy organization, whose mission is to defend the environment and champion a just and healthy world. The organization works to stop environmental damage and to protect human health and the planet by reducing pollution and reducing dependence on fossil fuels. Founded in San Francisco in 1969 by David Brower, Friends of the Earth now maintains its headquarters in Washington, D.C. and its West Coast office in San Francisco and is the U.S. voice of the world's largest network of grassroots environmental groups, with affiliates in over 75 countries.

[9] 40 C.F.R. § 140.1(a).

[10] EPA, National Management Measures Guidance to Control Nonpoint Source Pollution from Marinas and Recreational Boating 4-77 (2001), *available at* http://www.epa.gov/nps/mmsp/section4.11.pdf (last visited March 9, 2009).

[11] U.S. Government Accounting Office, Implementation of the Beach Act of 2000: EPA and States Have Made Progress Implementing the Act, but Further Actions Could Increase Public Health Protection 1 (2007), *available at* http://www.gao.gov/new.items/d071073t.pdf (last visited March 8, 2009) [hereinafter "Beach Act Report"].

[12] Beach Act Report, *supra* note 11, at 1; Joint Group of Experts on the Scientific Aspects of Marine Environmental Protections, A Sea of Troubles 5-6 (2001), *available at* http://unesdoc.unesco.org/images/0012/001229/122986e.pdf (last visited March 8, 2009) [hereinafter "GESAMP"].

[13] Beach Act Report, *supra* note 11, at 1; GESAMP, *supra* note 12, at 5-8.

[14] GESAMP, *supra* note 12, at 5-6.

to these elevated health risks.[15] Sewage discharges also impact coastal economies and access to beaches and recreation. Elevated levels of fecal coliform, for example, led to more than 25,000 days of beach advisories and closings in 2006.[16]

Additionally, sewage releases can endanger public health when discharges are made in the vicinity of shellfish beds. Shellfish and other filter feeders concentrate pathogens in their tissues, which can cause them to be unsafe for human consumption.[17] Pathogens and viruses can live in the sea for weeks, and can survive in shellfish for months. Studies indicate that "bivalve shellfish can bioaccumulate viruses in the range of 3 to 1,000 times the viral concentration in the overlying water."[18] When eaten raw or undercooked, these shellfish can pose considerable risk to consumers. "One in every hundred people eating relatively lightly contaminated raw shellfish will be infected with a moderately serious intestinal virus disease; the risk rises to up to 50 in 100 if the virus is highly infectious."[19]

Sewage-borne pathogens are also harmful to corals, causing disease and scarring in many coral species.[20] Nutrients such as nitrogen and phosphorous promote excessive algal growth, which consumes oxygen in the water and can lead to fish kills and the smothering of coral reefs. Eutrophication, or over-enrichment of nutrients, is also a cause of the loss of diversity in the sea floor community (including seaweeds, seagrasses, and corals), and among planktonic organisms. Planktonic algae are the basis of marine food webs and a change in the dominant plankton species can have a domino effect throughout the food web.[21]

Sewage discharged from vessels can also be visually repulsive and decrease the use of water bodies for activities such as: swimming, water skiing, snorkeling, scuba diving and surfing.

B. Cruise Ship Sewage Discharges

The large volume of sewage discharges from cruise ships highlights the need to update the applicable vessel discharge standards. Cruise ships, which can now carry passengers in numbers equivalent to small cities, generate and discharge significant volumes of sewage. These vessels, which can produce up to 74,000 gallons of sewage per day (the fleet average is 21,000 gallons of sewage per day, per vessel),[22] "bring millions

---

[15] *Id.* at 1-4.

[16] Mark Dorfman *et al.*, Natural Resources Defense Council, Testing the Waters: A Guide to Water Quality at Vacation Beaches 1, 3 (17th ed. 2007), *available at* http://www.nrdc.org/water/oceans/ttw/ttw2008.pdf (last visited March 8, 2009) [hereinafter "NRDC Testing the Waters"].

[17] The Washington State Department of health conducted a study on the impact to shellfish growing areas of viruses discharged from passenger vessels in the Puget Sound region. Due to the health risks associated with contaminated shellfish as a result of these discharges, the study recommended that cruise vessel discharges be banned within 0.5 nautical miles of shellfish harvesting areas, that cruise ships should not discharge when their treatment system is not functioning properly, and that the Department of Health should be notified in the event of a treatment system failure. The study compared several major cruise routes in proximity to shellfish growing areas: Five shellfish growing areas intersected, or were within 1000 feet of, large passenger vehicle traffic lanes. *See* Washington State Department of Health, Report to the Legislature Assessment of Potential Health Impacts of Virus Discharge from Cruise Ships to Shellfish Growing Areas in Puget Sound 1, 5, A1-A5 (2007); John Scott Meschke and John C. Kissel, Quantitative Assessment of Acceptable Levels of Virus Discharge from Cruise Ships in Puget Sound, Department of Environmental and Occupational Health Sciences, School of Public Health and Community Medicine 5 (2007).

[18] *Id.; see also* NRDC Testing the Waters, *supra* note 16, at 1, 3.

[19] GESAMP, *supra* note 12, at 6.

[20] Bruce McKay et al., Danger at Sea: Our Changing Ocean 1-18, *available at* http://www.seaweb.org/resources/documents/reports_dangeratsea.pdf (last visited March 8, 2009).

[21] *Id.*; *see also*, California Department of Boating and Waterways, Shipshape Sanitation – MSDs and Pumpouts, *available at* http://www.dbw.ca.gov/Pubs/Sanitation/index.htm (last visited March 8, 2009).

[22] EPA 2008 Cruise Ship Assessment, *supra* note 2, at 2-1.

of tourists to fragile ecosystems and protected areas each year, a dynamic that could threaten the sustainability of the resources on which the industry depends."[23]

An estimated seventy percent of cruise destinations feature biodiversity hotspots.[24] Sewage contamination threatens these pristine environments. As an example, "fecal contamination from untreated or inadequately treated sewage is thought to be a major source of harm to coral reefs and dependent species.[25] In 2002, "only five percent of the reefs surrounding Jamaica supported living coral compared to 60 percent" 20 years earlier and in 2002, "about 90 percent of Florida's coral reefs were believed to be dead or dying."[26] Both Jamaica and Florida have large numbers of cruise ships traveling in their waters.[27]

Current vessel sewage regulations governing this once small industry have not been updated to reflect the rapid growth of the global cruise industry. The cruise industry is the fastest growing tourism sector in the world – growing by over 107% in the past 10 years – a rate twice as fast as other travel sectors.[28] In 1970, approximately 500,000 passengers went on a cruise;[29] 37 years later, 9.2 million passengers embarked on cruises from North American ports alone.[30] Demand for cruise ship tourism continues to be steady; over thirty new cruise ships are scheduled to be introduced into the North American fleet by 2012.[31] Average ship capacity is also expected to increase annually by seven to ten percent over the next few years.[32] Unless countered by more stringent sewage regulations, this expected industry growth will exacerbate the health and environmental effects of vessel discharges.

II. Federal Regulation of Vessel Sewage

The Clean Water Act's main regulatory mechanism for controlling point source pollution is the National Pollutant Discharge Elimination System ("NPDES") program, which prohibits the discharge of any pollutant from a point source into navigable waters[33] without a permit.[34] Although "sewage" is defined as a pollutant[35]

---

[23] Conservation International, Cruises, http://www.biodiversityscience.org/xp/CELB/programs/travel-leisure/cruises.xml (last visited February 8, 2009).
[24] *Id.*
[25] NRDC Testing the Waters, *supra* note 16, at 28.
[26] The Ocean Conservancy, Cruise Control: A Report on How Cruise Ships Affect the Marine Environment, 22, (May 2002), *available at* http://www.oceanconservancy.org/site/DocServer/cruisecontrol.pdf?docID=141 (last visited March 9, 2009) [hereinafter "Cruise Control"].
[27] Over 4.5 million passengers departed from the three largest Florida ports in 2008 and over 65% of North American cruise passengers traveled to Caribbean waters. *See* U.S. Department of Transportation Maritime Administration, North American Cruise Statistics Snapshot, 4th Quarter 2008, 4, 6, *available at* http://www.marad.dot.gov/documents/North_American_Cruise_Statistics_Quarterly_Snapshot.pdf (last visited April 7, 2009).
[28] EPA 2008 Cruise Ship Assessment, *supra* note 2, at 1-1 *citing* Center for Environmental Leadership in Business (CELB) 2003, *A Shifting Tide: Environmental Challenges and Cruise Industry Responses,* Washington, DC., *available at* www.celb.org/ImageCache/CELB/content/travel_2dleisure/cruise_5finterim_5fsummary_2epdf/v1/cruise_5finterim_5fsummary.pdf; Cruise Industry News, Winter 2006/2007, *available at* http://www.cruiseindustrynews.com/cruise-news-articles.html?start=48 (last visited March 9, 2009).
[29] Cruise Lines International Association, Cruise Industry Sources Book 8 (2007).
[30] Cruise Lines International Association, The Contribution of the North American Cruise Industry to the U.S. Economy in 2007 2 (July 2008) [hereinafter "Economic Contribution 2007"].
[31] Economic Contribution 2007, *supra* note 30, at 98.
[32] *Id.* at 100.
[33] Under the CWA, navigable waters are defined as the waters of the United States including the territorial seas, which extend 3 miles from the shore. *See* 33 U.S.C. § 1362(7),(8); President Reagan's presidential proclamation in 1988 extending the territorial seas of U.S. waters to 12 nautical miles from the shoreline did not amend any statutory definitions. The exception phrase expressly states "[n]othing in this proclamation: a) extend or otherwise alters existing Federal or State law or any jurisdiction, rights, legal interest, or obligations derived therefrom...." *See* Proclamation No.

and cruise ships qualify as point sources,[36] "sewage from vessels" is exempt from the pollutant definition and does not require an NPDES permit.[37] Instead, the regulation of sewage discharges from vessels is reserved under section 312 of the CWA, which mandates all vessels equipped with onboard toilets to install a Coast Guard certified Marine Sanitation Device ("MSD") that treats vessel sewage before it is discharged into navigable waters.[38] When developing the performance standards for MSDs, the EPA is required to consider both the economic cost involved and "the limits of available technology."[39]

In 1976, the EPA established sewage effluent limits for three types of MSDs[40] certified by the Coast Guard. Under current EPA standards, Type II MSDs – the most common type of MSD used on cruise ships and other vessels with large volumes of sewage and other human wastewater – must be capable of producing an effluent with a "fecal coliform bacterial count of no greater than 200 per 100 milliliters [and] suspended solids [no] greater than 150 mg/l."[41]

Several states have initiated their own cruise ship regulations to ensure a greater level of protection and compliance with federal standards. Alaska, California, and Maine for example, have each instituted state regulations with effluent limits stricter than those set by the EPA.[42] Additionally, Washington and Florida have entered into Memorandums of Understanding ("MOUs") with segments of the cruise industry to

---

5928, 54 Fed. Reg. 777 (Dec. 27, 1988); President Clinton's 1999 proclamation extending the contiguous zone from 12 to 24 nautical miles also did not amend any statutory definitions, expressly stating that "nothing in [Proc. 7219] amends existing Federal or state law..." *See* Proclamation No. 7219, 64 Fed. Reg. 48,701 (Aug. 2, 1999).

[34] 33 U.S.C. § 1342.

[35] *Id.* § 1326(6). A pollutant is defined as "dredged spoil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rocks and, cellar dirt and industrial municipal, and agricultural waste discharged into water...."

[36] *Id.* § 1262(14). A point source is defined as "any discernible, confined and discrete conveyance, including, but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged."

[37] *Id.* § 1362(6).

[38] *Id.* § 1322(a)(5). An MSD is any equipment installed "on board a vessel which is designed to receive, retain, treat or discharge sewage, and any process to treat such sewage." The Coast Guard retains the authority to promulgate regulations "governing the design, construction, installation and operation of any marine sanitation device," and has a duty to certify a MSD model before it is placed on the market. *See id.* § 1322(b)(1). Additionally, the Coast Guard has the authority to inspect sewage discharge reports, test effluent discharge and impose civil penalties for violations.

[39] *Id.* § 1322(b)(1). Although section 312 does not explicitly refer to the necessary consideration of "best practicable control technology," it mirrors the NPDES requirement for this standard, by mandating consideration of cost and technological readiness.

[40] Type I MSDs are limited to vessels measuring up to 65 feet, Type II and Type III MSDs are authorized for all vessels. Type I and Type II MSDs consist of flow-through devices that break up and disinfect waste before discharge. Type III MSDs are essentially holding tanks that store sewage in various chemicals until it can be pumped out at a shore-side treatment facility, or flushed out without treatment beyond U.S. territorial waters. *See* U.S. Environmental Protection Agency, Marine Sanitation Devices - Vessel Sewage Discharge Program, http://www.epa.gov/owow/oceans/regulatory/vessel_sewage/vsdmsd.html (last visited Feb. 9, 2009).

[41] 40 C.F.R. § 140.3(d); 33 C.F.R. § 159.3.

[42] *See* Alaska Department of Environmental Conservation, Chapter 69: Commercial Passenger Vessel Environmental Compliance Program, May 18, 2006, *available at* http://www.legis.state.ak.us/cgi-bin/folioisa.dll/aac/query=%5Bgroup%2Btitle18chap69!3A%5D/doc/%7B@1%7D/hits_only? (last visited March 8, 2009); California Environmental Protection Agency, State Water Resources Control Board, NPDES SB771 California Clean Coast Act of 2005: Vessel Discharges, February 11, 2009, *available at* http://www.swrcb.ca.gov/water_issues/programs/npdes/sb771.shtml (last visited March 8, 2009); Maine Bureau of Land & Water Quality, Large Commercial Passenger Vessels (LCPVs) Chapter 532, *available at* http://www.state.me.us/dep/blwq/topic/vessel/LCPV/index.htm (last visited March 8, 2009).

encourage better waste management practices.[43] The demand for these initiatives reflects the concerns of states regarding harmful vessel discharges in their waters and highlights the need for updated federal regulation.

In December of 2008, in response to a petition filed in 2000 by the Bluewater Network[44] and 53 other organizations,[45] the EPA released a Cruise Ship Discharge Assessment Report ("2008 Cruise Ship Assessment") assessing cruise ship waste streams, effectiveness of treatment systems, regulatory compliance, and regulatory recommendations. The 2008 Cruise Ship Assessment highlighted both the poor performance of current Type II MSDs and the improvements offered by advanced wastewater treatment systems ("AWTS"), a more advanced marine sanitation device that is already installed on the majority of cruise ships operating in Alaskan waters. The 2008 Cruise Ship Assessment compiled public comments concerning alternative measures that would improve water quality and the current effluent standards, but failed to endorse any of the recommendations or alternative standards and enforcement measures proposed by the petitioners and other commentors.[46] Although EPA has recently taken steps to regulate "discharges incidental to the normal operation of a vessel" under the NPDES Vessel General Permit, the discharge of sewage from vessels remains unaddressed.[47]

III. Current MSD Requirements are Inadequate to Protect U.S. Waters; Type II MSDs Routinely Fail to Meet Current EPA Standards

Traditional Type II MSDs routinely fail to treat sewage to meet the current EPA standards[48] and are inadequate to protect U.S. waters. A 2000 voluntary sampling initiative, conducted in Alaskan waters by state and federal agencies, tested effluent quality for priority pollutants and common wastewater indicators, including fecal coliform, total suspended solids, biochemical oxygen demand, chemical oxygen demand, chlorine, pH, metals and ammonia.[49] Nearly all of the samples failed to comply with the current federal sewage discharge standards in 40 C.F.R. § 140 for both fecal coliform and total suspended solids.[50] Only 1 of the 70 samples met both of these standards. Fifty seven percent of the samples exceeded the federal standard for fecal coliform and 68 percent exceeded the limit for total suspended solids.[51] *The average concentration*

---

[43] *See* Florida Department of Environmental Protection, Memorandum of Understanding, December 6, 2001, *available at* http://www.dep.state.fl.us/legal/Operating_Agreement/agreements/Cruise%20Line/cruiselineMOU12-06-01.pdf (last visited March 8, 2009); Washington State Department of Ecology, Memorandum of Understanding Cruise Operations in Washington State, April 20, 2004, *available at* http://www.ecy.wa.gov/PROGRAMS/WQ/wastewater/cruise_mou/FINALamendment4MOU051908.pdf (last visited March 8, 2008).

[44] Bluewater Network merged with Friends of the Earth in 2005.

[45] Bluewater Network, Petition to the Administrator, U.S. Environmental Protection Agency, March 17, 2000, *available at* http://www.epa.gov/owow/oceans/cruise_ships/disch_assess.html (last visited March 8, 2009).

[46] EPA 2008 Cruise Ship Assessment, *supra* note 2, at 1-8 – 1-9.

[47] *See* U.S. Environmental Protection Agency, National Pollutant Discharge Elimination System, Vessel General Permit for Discharge Incidental to the Normal Operation of Vessels (VGP) § 1.2.3.2. (2008) *available at* http://www.epa.gov/npdes/pubs/vessel_vgp_permit.pdf (last visited March 8, 2009); *Northwest Environmental Advocates v. EPA*, 537 F.3d 1006 (9th Cir. 2008) (affirming the district court's summary judgment in favor of the plaintiffs who petitioned the EPA to repeal 40 C.F.R. § 122.3(a) in 1999 after claiming that it violated the CWA).

[48] Alaska Cruise Ship Initiative, Alaska Department of Environmental Conservation, Interim Report 13 (Part 2 2001) [hereinafter "ADEC Report"].

[49] *Id.* at 11.

[50] The federal standard for fecal coliform is 200 colonies/100 ml and 150mg/l for total suspended solids. *See* 33 C.F.R. § 159.3; 40 C.F.R. § 140.3(d); EPA 2008 Cruise Ship Assessment, *supra* note 2, at 2-9. *See also* ADEC Report, *supra* note 48, at 13.

[51] EPA 2008 Cruise Ship Assessment, *supra* note 2, at 2-9; ADEC Report, *supra* note 48, at 13-14.

of fecal coliform in MSD effluent exceeded the EPA standard by 10,200 times.[52]

The testing results for other priority pollutants and analytes not regulated by current federal sewage standards were equally disappointing. Tests detected levels of contaminants exceeding EPA water quality standards, including the National Recommended Water Quality Criteria ("NRWQC").[53] Although these water quality indicators are not regulated under Type II MSD standards, the testing detected highly elevated levels of chlorine, biological oxygen demand, metals, organics and nutrients, posing a significant risk to marine ecosystems, aquatic life and human health.[54]

Additionally, the EPA has acknowledged that the performance of Type II MSDs decreases over time[55] and the Alaska Department of Environmental Conservation has stated that "the MSDs currently being used on cruise ships were found to be incapable of treating the sewage to the level that manufacturers claim, and the Coast Guard required through their certification process."[56]

IV. EPA Must Update Type II MSD Standards to Reflect the Best Practicable Control Technology Available

Section 312(b)(1) of the Clean Water Act requires EPA, "after giving appropriate consideration to the economic costs involved, and within the limits of available technology, [to] promulgate Federal standards of performance for marine sanitation devices...which shall be designed to prevent the discharge of untreated or inadequately treated sewage into or upon the navigable waters from new and existing vessels."[57]

As demonstrated above, Type II MSDs have proven inadequate in effectively treating the large and growing volumes of sewage being discharged into navigable waters from large passenger vessels. Cost effective technology exists to more effectively treat sewage from vessels. EPA must promulgate new standards reflecting this available advanced treatment technology to prevent the continued discharge of inadequately treated sewage into navigable waters and to meet the Congressional goal of protecting our Nation's waters.

A. Effective Advanced Technology for Vessel Sewage Treatment is Available

Traditional Type II MSDs routinely fail to meet federal water quality standards and protect human health and the environment. Currently available technologies exist that can provide increased treatment and disinfection of sewage effluent from vessels. For example, prompted by the 2000 passage of Title XIV in Alaska, allowing the imposition of strict water quality standards, cruise ships are required to use advanced wastewater treatment systems ("AWTS") or hold and discharge outside of certain Alaskan waters.[58] As a result, many

---

[52] The average concentration of fecal coliform was 2,040,000 MPN/100 ml. This is significantly greater than the 10,000 to 100,000 MPN/100 ml in untreated domestic wastewater. The average concentration of Total Suspended Solids was 627 (mg/l) compared to the concentration of 100-350 (mg/l) found in untreated domestic wastewater. *See* EPA 2008 Cruise Ship Assessment, *supra* note 2, at 2-9.

[53] As reported by the EPA, "NRWQC are recommended concentrations of analytes in a waterbody that are intended to protect human health and aquatic organisms and their uses from unacceptable effects from exposures to these pollutants." *Id.* at 2-25. The testing results for the other priority pollutants and analytes not regulated by federal standards detected levels exceeding water body quality standards set by the EPA, including the NRWQC. *See id.* at 2-25 - 2-36.

[54] *See* Appendix 1 for the MSD testing results. *See also* EPA 2008 Cruise Ship Assessment, *supra* note 2, 2-9 – 2-11, 2-30 – 2-34, for a complete summary of the MSD data collected in Alaska during the 2000 voluntary sampling initiative.

[55] 33 C.F.R. § 159.3; U.S. Environmental Protection Agency, Cruise Ships White Paper 13 (2000).

[56] ADEC Report, *supra* note 48, at 6.

[57] 33 U.S.C. § 1322(b)(1).

[58] Title XIV established more stringent discharge standards for sewage on large cruise ships operating in Alaskan waters. *See* "Certain Alaskan Cruise Ship Operations" in 33 U.S.C. § 1901 Note.

cruise ships operating in Alaska are using these more effective treatment systems to treat their wastewater discharges.[59] The International Council of Cruise Lines estimates that in 2007, about 40 percent of North American cruise ships -- accounting for approximately two-thirds of the world fleet -- have installed AWTS.[60] According to the EPA, "AWTS generally provide improved screening, biological treatment, solids separation (using filtration or flotation), disinfection (using ultraviolet light), and sludge processing as compared to traditional Type II MSDs."[61]

The EPA evaluated AWTS data collected in Alaska between 2003 and 2005.[62] Upon review of the sampling data, EPA concluded that AWTS are effective in removing fecal coliform and suspended solids from vessel sewage to levels more stringent than those set out in current EPA standards for Type II MSDs.[63] The average concentration of fecal coliform in the AWTS effluent was 14.5 colonies/100 ml,[64] which is considerably lower than the federal standard of 200 colonies/100 ml. Similarly, the average concentration of total suspended solids in the AWTS effluent was 4.49 mg/l[65] which is also lower than the federal 150 mg/l standard.[66]

Industry data also support the effectiveness of AWTS. A primary AWTS manufacturer, Hamworthy KSE, reports that its "[AWT] system developed has been shown to be capable of treating combined wastewater streams generated on board ships to the highest effluent quality standards."[67] Independent testing of Hamworthy AWTS[68] has supported this claim as to fecal coliform which were detected at levels between 3 to 13 colonies/100 ml and total suspended solids at levels between 2 to 18 mg/l.[69]

---

[59] The systems include the Hamworthy Membrane Bioreactor (MBR), ROCHEM LPRO and ROCHEM Bio-Fil System, Zenon ZeeWeed MBR System and Scanship treatment system and the Hydroxyl CleanSea system. *See* EPA 2008 Cruise Ship Assessment, *supra* note 2, at 2-12.

[60] Charles Q. Choi, Cruise Lines Face More Policing of Waste Disposal, New York Times, March 25, 2007, *available at* http://travel.nytimes.com/2007/03/25/travel/25heads.html?pagewanted=print.

[61] EPA 2008 Cruise Ship Assessment, *supra* note 2, at 2-12.

[62] The analysis is adapted from the EPA Final Cruise Ship Assessment Report based on data collected in Alaska between 2003 and 2005. More recent sampling by the EPA during the 2008 cruise season is not yet available. *See id.* at 1-4. The EPA analyzed AWTS samples taken by ADEC and the Coast Guard from 2003 to 2005. Under federal law, the cruise ships operating in Alaska were required to provide discharge samples to ADEC. The sampling tested for fecal coliform as well as other priority and common pollutants. *See id.* at 2-13. The cruise industry also provided self-monitoring data that was submitted in response to an EPA cruise ship survey conducted in 2004; the submitted AWTS discharge data from six cruise ships represents less than 2% of the data. *See id.* at 2-14. The AWTS data comes from the following four systems used to treat both sewage and some graywater sources: Hamworthy Membrane Bioreactor (MBR), ROCHEM LPRO and ROCHEM Bio-Filt, ZENON ZeeWeed MRB and Scanship. These were the only continuous discharge systems certified for use in Alaska before 2005. Depending on the type of system, some combine both sewage and gray water in the same tank before discharging. *See id.* at 2-14, 2-12 - 2-23.

[63] 40 C.F.R. § 140.3(d) requires Type II MSDs to be capable of producing an effluent with a "fecal coliform bacterial count of no greater than 200 per 100 milliliters [and] suspended solids [no] greater than 150 mg/l" yet the AWTS tested in Alaska were capable of lowering the pathogen levels, including fecal coliform, to levels below detection, a removal rate greater than 99%. *See id.* at 2-13, 15.

[64] The average concentration of fecal coliform was detected at 14.5 colonies/ml (26 detects out of 285 samples). *See id.* at 2-15.

[65] The average concentration of total suspended solids was detected at 4.49 mg/l. *See id.* at 2-25.

[66] *Id.* at 2-15, 2-25.

[67] Allen Bentley & Allen Smith, Hamworthy KSE, The Optimization of Membrane Bioreactor Technology for Use in the Treatment of Marine Wastewater 8.

[68] KSE tested a 60-ton AWT MBR at a land-based plant and collected results over a 12-week monitored period. In addition, Hamworthy also installed and tested the Membrane Bioreactors (MBR) on the Princess cruise vessel *Star Princess* and the Radisson Seven Seas *Seven Seas Navigator* cruise vessel; *see* Allen Bentley & Ian Ballard, Hamworthy KSE, Black & Grey Water Treatment Solutions Using Membrane Bioreactors 5.

[69] Princess Cruise Ship MBR: Sampling over a ten week period. *See* Case Study, Hamworthy, Membrane Bioreactor 28,550 Grt. Cruise Ship Grey and Black Water Treatment Plant Retrofit (Ref: HM0044 0607/4) (on file with the author),

While AWTS were demonstrated effective in EPA testing in removing particulate metals and volatile and semi-volatile organics to levels below detection, EPA's testing revealed that AWTS only removed 37 to 50 percent of dissolved metals and were only moderately effective in reducing nutrients.[70] In its 2008 Cruise Ship Assessment, the EPA suggested several upgrades to current AWTS that can result in lowered levels of nutrients and metals. These upgrades include biological nitrification, ion exchange, reverse osmosis and chemical precipitation, to achieve reductions in the levels of ammonia, nitrogen, phosphorus and metals. To date, these additional technologies have not been tested on cruise ship wastewater effluent. However, the "EPA believes these technologies are potentially feasible for this application because they currently are used in other shipboard applications or because they currently are used in land-based wastewater treatment facilities and could be adapted for shipboard application."[71] Additionally, EPA did not provide data on AWTS ability to remove viruses and other studies indicate that virus removal remains an unresolved issue for AWTS.[72]

B. Monitoring, Recordkeeping and Reporting Requirements Should be Included in Any Updated Sewage Treatment Standards

To guarantee the protection of the oceans and navigable waterways, as set forth in the CWA,[73] the EPA should set monitoring, recordkeeping and reporting requirements for current, or any updated, vessel discharge standards. Non-compliance with current federal discharge standards will continue without an EPA requirement for adequate monitoring, recordkeeping and reporting by vessel operators. Although the Coast Guard has authority under CWA to enforce compliance with federal discharge standards, vessel operators are not required to continually monitor or record compliance throughout the life cycle of an MSD.[74] Currently, the Coast Guard conducts quarterly inspections of cruise ships focusing heavily on "safety and seaworthiness" and with limited to no review of environmental compliance and pollution prevention protocols.[75]

Implementing a monitoring, recordkeeping, and reporting requirement for sewage discharges will not prove

---

Case Study, Hamworthy, Membrane Bioreactor 108,977 Grt. Cruise Ship Grey and Black Water Treatment Plant Conversion (Ref: HM0046 0607/3) (on file with the author).

[70] Although the EPA standards only include fecal coliform and total suspended solids, the AWTS were effective in reducing the amounts of other pollutants and analytes - including metals and organics. *See* Appendix 1; *See also, id.* at 2-13 - 2-21.

[71] EPA 2008 Cruise Ship Assessment, *supra* note 2, at 2-38 - 2-41. *See also* Alaska Department of Environmental Conservation, 2009 Cruise Ships Wastewater Technology Workshop Presentations, February 18, 2009, *available at* http://www.dec.state.ak.us/water/cruise_ships/2009_Tech_Workshop_Present.html (last visited March 9, 2009).

[72] EPA 2008 Cruise Ship Assessment, *supra* note 2, at 2-15. *See also* Assessment of Potential Health Impacts of Virus Discharge from Cruise Ships to Shellfish Growing Areas in Puget Sound, Washington Department of Health, November 2007, http://www.doh.wa.gov/ehp/sf/Pubs/cruise-ship-report.pdf at 1 (last visited April 3, 2009).

[73] 33 U.S.C. § 1251(a).

[74] The Coast Guard has the authority to inspect sewage discharge reports, test effluent discharge and impose civil penalties for violations. A civil penalty of $2,000 to $5,000 per violation may be imposed for failure to equip a vessel with an operable MSD, tampering with an installed MSD or selling non-certified MSDs. *See* 33 U.S.C. § 1322(k), (j).

[75] Generally, the inspectors will review compliance records, MARPOL required equipment, and oil discharge systems. Several factors limit the ability of the Coast Guard to make a detailed inspection of the environmental compliance and pollution prevention equipment on ships, including: budget limitations, resource constraints, time constraints, advance notice of inspections, passenger safety and other Coast Guard priorities including homeland security and drug interdiction. These restrictions leave limited resources for environmental compliance, making it difficult to identify malfunctions, improper installations or operational deficiencies of MSDs. *See* Cruise Control, 38, 39, *supra* note 26; U.S. Government Accounting Office, Marine Pollution: Progress Made to Reduce Marine Pollution by Cruise Ships, but Important Issues Remain 13 (2000); Claudia Copeland, Congressional Research Service, Cruise Ships Pollution: Background, Laws and Regulations, and Key Issues 11 (2008).

difficult and is already required for all other discharges from large vessels.[76] The EPA requires vessels to monitor and report a range of discharges incidental to the normal operation of a vessel. Monitoring, recordkeeping and reporting are an integral part of the Clean Water Act and together they are used to ensure that the marine environment and public health and welfare are not compromised by a lack of vigilance and oversight. At a minimum, EPA should require monthly monitoring and reporting of all discharges from Type II MSDs and also require daily observations of treatment equipment operation and effectiveness. This minimum monitoring frequency will demonstrate that all treatment and pollution control systems are functioning properly. Frequent monitoring and reporting not only provides vessel operators with information as to how well their treatment systems are operating, but also provides EPA with consistent data as to vessel compliance, or the lack thereof. Adequate monitoring, recordkeeping and reporting also provides assurances to the public that vessels are in compliance with Clean Water Act requirements. Records of monitoring and testing results should be submitted monthly to EPA and maintained by the vessel operator for at least five years.

Technological advancements and existing international regulations have made telemetric, and thus more frequent, monitoring of vessel discharges possible. Pursuant to the International Maritime Organization's International Convention for the Safety of Life at Sea, for example, all large passenger ships and cargo ships engaged on international voyages must be fitted with a communication system capable of automatically transmitting the identity, position and time and date of the ship's position to regulatory authorities in destination countries.[77] Technologies that merge this GPS tracking technology with the monitoring, recordkeeping and reporting of large vessel discharges are already available. For example, current technology exists to monitor bilge discharges, including the ability to personalize the monitoring of criteria pollutants by the vessel operators, in conjunction with a vessel's GPS position. Routine reports of dischargers and ship locations, as well as any event alarms, can be sent to any shore e-mail, fax or mobile phone via a communication application.[78] Finally, mandating that Type II MSD performance standards include monitoring and reporting of discharges will foster the development and adoption of new technologies, improving the availability and efficacy of alternate wastewater treatment system and monitoring technology.

C. New AWTS Technology Would Only Cost $7.09 Per Passenger

The availability of more effective sewage treatment technologies demonstrates that current federal regulations are outdated and must be brought up to date to reflect the best practicable control technologies. Requiring the installation and operation of alternative treatment systems on large vessels is cost-effective. EPA estimates that it would cost $7.09 per passenger to operate and maintain a new AWTS system on a large cruise ship.[79]

A wide range of advanced wastewater treatment systems are currently available, and most Type II MSD systems can be converted into these advanced treatment systems.[80] Some AWTS are available as complete modular packages, which can minimize the costs of installation. The installation of AWTS on a cruise ship

---

[76] Vessels include, cruise ships, research vessels, ferries, oil or petroleum tankers, barges, bulk carriers, cargo ships, container ships, cargo freighters, mobile offshore drilling units, refrigerant ships, government vessels not part of the armed forces, emergency response vessels, and any other vessels operating in a capacity of transportation. *See* EPA, "Economic and Benefits Analysis of the Final Vessel General Permit (VGP)," December 18, 2008.

[77] International Maritime Organization ("IMO"), Adoption of Amendments to the International Convention for the Safety of Life at Sea, 1974, as Amended, Res. Msc. 202 (81) (May 19, 2006), *available at* http://www.imo.org/includes/blastDataOnly.asp/data_id%3D24228/MSC.202%2881%29.pdf.

[78] *See* Rivertrace Engineering Ltd., SmartSafe Bilge Overboard Security System, *available at* http://www.rivertrace.com/products/marine_applications/3 (last visited March 9, 2009).

[79] EPA, "Economic and Benefits Analysis of the Final Vessel General Permit (VGP)," 76-77 (2008).

[80] Available systems include the Hamworthy MBR system, the ROCHEM LPRO system, the ROCHEM Bio-Filt system, the Zenon ZeeWeed MBR system, the Scanship treatment system and the Hydroxyl CleanSea system. *See* EPA 2008 Cruise Ship Assessment *supra* note 2, at 2-13, 14.

costs roughly between $2 to $10 million per ship.[81] Over a five-year period, an entire cruise line can be fitted with advanced treatment systems for the cost of a can of cola per passenger per day.[82] Royal Caribbean International, the second largest cruise operator in the industry, is investing $100 million to equip their *entire* fleet with AWTS[83] in an effort to counter negative public perception for past environmental violations. Yet, to date, Royal Caribbean has only installed AWTS on 38 percent (8 of 21) of its cruise ships, and of all cruise ships operating in U.S. waters only 40 percent (approximately 58 of 145) have installed AWTS. Although Royal Caribbean's investment seems sizable, the sum is negligible when compared to cruise line profits. In 2007, Carnival, Royal Caribbean, Norwegian and Disney dominated the market – accounting for 98% of all overnight passengers – and generated over $21 billion in revenue and a profit of $3 billion for Carnival and Royal Caribbean alone.[84]

Requiring industry-wide performance standards to reflect the best practicable control technology currently available will also serve as an economic stimulus by spurring innovation and encouraging the deployment of newer technology, as evidenced by the Alaskan example where AWTS are now standard technology based on protective standards. Mandating greater efficacy in effluent treatment for a large sector of the global tourism industry would also impact the investment and the resources geared toward the development of new technology; a move that could result in less costly, more efficient systems capable of meeting more stringent effluent standards.

V. Conclusion

Cruise ships travel to and from ports all over the U.S. and have significant impacts on our marine environments and human health.[85] The current regulatory program for the treatment of sewage from these and other large vessels is woefully inadequate and has failed to keep up with both the growth of the industry and the development of sewage treatment technologies. Federal regulations governing the discharge of sewage effluent from vessels are outdated and must be modernized to incorporate treatment and monitoring technologies already on the market and utilized by 40 percent of the cruise ships travelling our waters.

State standards have led the development of these new technologies, but a minimum standard requiring the use of these technologies across all U.S. waters and by all cruise lines is crucial. EPA correctly acknowledged, almost nine years ago, that the applicable "standards were developed in 1976 and may no

---

[81] Choi, *supra* note 60.

[82] Oceana, Needless Cruise Pollution: Passengers Want Sewage Dumping Stopped 1, 6, *available* at http://oceana.org/fileadmin/oceana/uploads/cruise_pollution/polling_report.pdf (last visited April 9, 2009).

[83] Press Release, Royal Caribbean, Royal Caribbean International Advanced Wastewater Purification Systems (Apr. 14, 2008), *available at* http://www.royalcaribbean.com/content/en_US/pdf/AWP_Updates/RCI_AWP_WebUpdateApr2008.pdf.

[84] U.S. Department of Transportation Maritime Administration, North American Cruise Statistics Snapshot, 2 (4th Quarter 2007); Cruise Industry Wire, *Royal Caribbean Reports Record Third Quarter Earnings and Comments on Current Environment*, October 28, 2008, *available at* http://www.cruiseindustrywire.com/article35348.html (last visited March 9, 2009); Cruise Industry Wire, *Royal Caribbean Reports Fourth Quarter Earnings and Provides an Update on the 'Wave' Period*, January 29, 2009, *available at* http://www.cruiseindustrywire.com/article36817-Royal_Caribbean_Reports_Fourth_Quarter_Earnings_and_Provides_an_Update_on_the__Wave__Period.html (last visited March 9, 2009); AOL Money and Finance, Royal Caribbean Cruises Financial Overview, March 9, 2009, *available at* http://finance.aol.com/financials/royal-caribbean-cruises-ltd/rcl/nys (last visited March 9, 2009); Cruise Industry Wire, *Carnival Corporation plc Reports Fourth Quarter and Full Year Earnings*, October 28, 2008, *available at* http://www.cruiseindustrywire.com/article36310-Carnival_Corporation___plc_Reports_Fourth_Quarter_and_Full_Year_Earnings.html (last visited March 9, 2009).

[85] Cruise ships travel to ports in Florida, South Carolina, Virginia, Maryland, Pennsylvania, New Jersey, New York, Maine, Massachusetts, Texas, Louisiana, Alabama, California, Washington, Alaska and Hawaii and travel in all coastal and Great Lakes waters.

longer be sufficiently stringent in light of available new technologies."[86] Federal law requires the EPA to protect the nation's waters and such protection necessitates the EPA to update current Type II MSD standards by incorporating the best practicable control technology available. Updating Type II MSD regulations to account for available technological improvements and efficiencies is both warranted and long overdue.

Therefore, Friends of the Earth respectfully requests that the Administrator:

1) Issue standards under section 312 of the Clean Water Act updating the vessel sewage discharge performance standards found in 40 C.F.R. § 140 for Type II Marine Sanitation Devices;

2) Create strong monitoring, recordkeeping and reporting requirements under section 312 to ensure compliance with vessel discharge performance standards.

As required by law, the EPA is required to give this petition prompt consideration. Additionally, under the Administrative Procedure Act, agency action includes the failure to act. Therefore, Friends of the Earth requests a substantive response to this Petition within 180 calendar days.

Thank you very much for your consideration. We look forward to your response.

Sincerely,

Malgorzata Bereziewicz
Student Advocate for Petitioner

Ashley Shattles
Student Advocate for Petitioner

Michael Robinson-Dorn
WSBA #: 29856
Attorney for Petitioner

University of Washington School of Law
Berman Environmental Law Clinic
William H. Gates Hall, Suite 265
University of Washington
P.O. Box 85110
Seattle, WA 98145-1110

FOR PETITIONER FRIENDS OF THE EARTH

Cc: Michael H. Shapiro, Acting Assistant Administrator, U.S. EPA Office of Water

[86] 33 C.F.R. § 159.3; U.S. Environmental Protection Agency, Cruise Ships White Paper 13 (2000).

Appendix 1: Comparison of Selected Analyte Concentrations in Type II MSD and AWTS Effluent

Analyte	Performance Standards for Type II MSDs (33 CFR Part 159 Subpart C)	Average Concentration in Cruise Ship AWT Effluent (+/- SE) (1)	Average Concentration in Cruise Ship Type II MSD Effluent (+/- SE) (2)	Percent Removal in Cruise Ship AWT Effluent
Pathogen				
Fecal Coliform MPN/100 ml	<200	14.5* (26 detects out of 285 samples)	2,040,000* (92 samples)	>99
Conventional Pollutants and Other Common Analytes				
Total Suspended Solids (mg/l)	<150	4.49* (+/- 0.193) (73 detects out of 587 samples)	627 (+/- 94.3) (21 detects out of 21 samples)	>99
Biochemical Oxygen Demand (5-Day)(mg/l)		7.99* (+/- 0.798) (358 detects out of 568 samples)	133 (+/- 15.2) (21 detects out of 21 samples)	>99
Chemical Oxygen Demand (mg/l)		69.4* (+/- 4.03) (139 detects out of 147 samples)	1,040 (+/- 271) (3 detects out of 3 samples)	>93 to 97
Total Residual Chlorine (mg/l)		0.338* (+/- 0.129) (41 detects out of 547 samples)	1.07* (+/- 0.499) (12 detects out of 18 samples)	
Ammonia				
Ammonia (as Nitrogen) (mg/l)		36.6* (+/- 5.50) (136 detects out of 138 samples)	145 (+/- 36.7) (21 detects out of 21 samples)	58 to 74
Metals				
Copper (Total) (ug/l)		16.6* (+/- 2.74) (69 detects out of 71 samples)	954* (+/- 398) (19 detects out of 24 samples)	96 to 98
Zinc (ug/l)		198* (+/- 22.7) (69 detects out of 71 samples)	514* (+/- 97.3) (19 detects out of 22 samples)	NC to 86
Nickel (ug/l)		13.6* (+/- 2.01) (70 detects out of 71 samples)	15.8* (+/- 7.34) (5 detects out of 22 samples)	NC to 48
Volatile and Semivolatile Organics				
Bis(2-ethylehexyl) phthalate (ug/l)		6.66* (+/- 0.721) (2 detects out of 71 samples)	3.45* (+/- 0.837) (16 detects out of 21 samples)	>37 to >90
Tetrachlorethylene (ug/l)		5.59* (+/- 1.05) (10 detects out of 71 samples)	12.5* (+/- 10.5) (3 detects out of 22 samples)	>44 to 97

Source: Adapted from U.S. Environmental Protection Agency, Cruise Ship Discharge Assessment Report, 2-8 – 2-34 (2008).

(1) Based on data collected in Alaska between 2003 and 2005: Sampling from three sources (1) EPA sampling, (2) ADEC/Coast Guard sampling, and (3) EPA Cruise Ship Survey.
(2) Based on ACSI in 2000: 21 cruise ships sampled – 19 using traditional Type II MSDs and 2 using advanced wastewater treatment systems (reverse osmosis).
(3) * Average includes at least one nondetect value; this calculation uses detection limits for nondetected results.
(4) "NC" indicates that percent removal was not calculated because the effluent concentration was greater than the influent concentration or the analyte was not detected in the influent samples from one or more sampled ships.

I. Sewage Discharge Testing Results

A. MSD Testing Results

A 2000 voluntary sampling initiative, conducted in Alaskan waters by state and federal agencies, tested effluent quality for priority pollutants and common wastewater indicators, including fecal coliform, total suspended solids, biochemical oxygen demand, chemical oxygen demand, chlorine, pH, metals and ammonia.[87]

i. *Chlorine*

The elevated effluent concentrations of residual chlorine exceeded the NRWQC. Chlorine was detected at an average of 1,070 ug/l compared with the NRWQC criteria (maximum concentration of residual chlorine) of 13 ug/l. Concentrations of chlorine as low as 3 ug/l can result in high mortality for some species and low levels can cause avoidance behavior, respiratory problems and hemorrhaging.[88]

ii. *Metals*

The elevated levels of metals can be toxic to marine life, particularly toxic to species of algae, crustaceans and fish, by disturbing biochemical, physiological and behavioral patterns.[89] Out of the 13 pollutants sampled for in the ACSI, 8 were detected in more than 10% of the samples: These included cadmium, chromium, copper, lead, mercury, nickel, silver, and zinc. Zinc and copper were detected in the highest concentrations. Total copper was detected at 954 ug/l and zinc was detected at 514 ug/l. An elevated level of nickel was also detected at 15.8 ug/l. Copper, nickel and zinc were detected at levels exceeding, by one to four times, the NRWQC for aquatic life.[90]

iii. *Organics*

The sampling considered 140 volatile and semivolatile organic analytes, sixteen of which were found in at least 10% of the samples. Some of the analytes with the greatest amounts were chlorine byproducts, which are believed to have been created through sewage chlorination in the MSD treatment process.[91] Six of the organics exceeded the NRWQC include bis(2-ethylehexyl) phthalate, a chemical used in plastics; carbon tetrachloride, used as an industrial solvent; bromodichloromethane and dibromochloromethane, byproducts of chlorine resulting from the reaction of chlorine with organic matter, and tetrachlorethylene, commonly used in the dry-cleaning process.[92]

---

[87] EPA 2008 Cruise Ship Assessment, *supra* note 2, at 2-9, 2-12, 2-13, 2-30 - 2-34.
[88] *Id.* at 2-30, 2-31.
[89] *Id.* at 2-31.
[90] *Id.* at 2-31.
[91] *Id.* at 2-10, 2-11.
[92] *Id. a*t 2-32, 2-33.

iv. *Nutrients*

Nutrients are common in sewage and some, like nitrogen and phosphorus, are important for marine life. However, elevated levels of nutrients can disturb marine processes and ecosystems by killing coral and sea grasses, eutrophication and increasing the occurrence of harmful algal blooms.[93] The ACSI sampling also detected ammonia, a by-product of the treatment process in the effluent. Depending on the temperature, salinity and pH of the water, the unionized form of ammonia can be toxic to marine life especially fish, affecting equilibrium, respiratory and cardiac systems, and may cause death.[94] Ammonia was sampled and found to have 145 mg/l compared to 12-50 mg/l in untreated domestic wastewater.[95] Ammonia exceeded all of the NRWQC standards calculated for at least eight cruise ship ports of call in the United States.[96]

v. *Oxygen Demand*

An elevated level of oxygen demand was also detected. Since most marine life is dependent on oxygen, reduction in levels limits available oxygen for fish and other aquatic species. Biological oxygen demand measures the reduction in the amounts of dissolved oxygen in the water resulting from biological processes. The bacteria, pathogens, viruses, and other micro-organisms in the water use the available oxygen as part of respiration during decomposition. When the oxygen levels decrease the ability to decompose becomes limited.[97] The average biochemical oxygen demand (5-Day) (mg/l) from Type II MSD effluent was 133 as compared to 110 to 400 mg/l in untreated domestic wastewater.[98]

B. Advanced Wastewater Treatment System Testing Results

The AWTS data is adapted from the EPA Cruise Ship Discharge Assessment Report and based on data collected in Alaska between 2003 and 2005 to evaluate advanced wastewater treatment systems.[99]

i. *Oxygen Demand*

The AWTS systems were effective in removing more than 99% of the biochemical oxygen demand (5-Day), 93 to 97% of the chemical oxygen demand. The average concentration of biochemical oxygen demand in AWTS effluent was detected at 7.99 mg/l (+/- .798) (358 detects out of 568 samples). The average concentration of chemical oxygen demand in AWTS effluent was detected at 69.4 mg/l (+/- 4.03) (139 detects out of 147 samples).[100]

ii. *Chlorine*

The average concentration of chlorine in cruise ship AWTS effluent was detected at .338 mg/l (+/- 0.129) (41 detects out of 547 samples).[101]

iii. *Metals*

The samples were also tested for 54 primary pollutants and dissolved metal analytes. The analysis found that most of the metals are primarily dissolved after AWTS treatment - supporting the efficacy of AWTS in removing particulates and promising future potential in reducing metals to levels below detection. Overall, the AWTS remove 37% to 50% of dissolved metals. Of the metals tested, 12 metals tested in levels above 10%: antimony, arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium, and zinc. The highest concentrations of metals detected were copper, nickel and zinc. *Copper:* The AWTS was effective in removing 62% to 94% of the dissolved copper and 96% to 98% of total copper. The average

---

[93] *Id.* at 2-33.
[94] *Id.*; ADEC Report, *supra* note 48, at 13.
[95] EPA 2008 Cruise Ship Assessment, *supra* note 2, at 2-11.
[96] *Id.* at 2-34.
[97] Meredith Dahl, *The Federal Regulation of Waste From Cruise Ships in U.S. Waters*, 9 Envtl. Law 609, 632 (2003).
[98] EPA 2008 Cruise Ship Assessment, *supra* note 2, at 2-9 - 2-10.
[99] *Id.* at 2-13.
[100] *Id.* at 2-16.
[101] *Id.*

concentration in cruise ship AWTS effluent was detected at 13.7 ug/l (+/- 2.40) (65 detects out of 71 samples) and the amount of total copper detected was 16.6 ug/l (69 detects out of 71 samples); *Nickel:* The AWTS was effective in removing up to 32% of the dissolved nickel and up to 48% of total nickel. The average concentration in cruise ship AWTS effluent was detected at 13.3 ug/l (+/- 1.96) (69 detects out of 71 samples) and the amount of total nickel detected was 13.6 ug/l (+/- 2.01) (70 detects out of 71 samples); *Zinc:* The average concentration of zinc in cruise ship AWTS effluent was 185 ug/l (+/- 21.4) (70 detects out of 71 samples) and the amount of total zinc detected was 198 ug/l (69 detects out of 71 samples).[102]

iv. *Organics*

The AWTS are effective at removing volatile and semi volatile organics to levels below detection. The organics detected in greater than 10% of the influent and/or the effluent are: 2,4 dichlorophenol, bis(2-ethylhexyl) phthalate, chloroform, diethyl phthalate, di-n-butyl phathalate, phenol, tetrachloroethylene, toluene, and trichloroethene. The following seven organics were also detected in at least 10% of the Type II MSD samples during the ACSI sampling: bis(2-ethylehexyl) phthalate, chloroform, diethlyphthalate, phenol, toluene and tetrachlorethylene. Removal rates of these chemicals ranged from 37 to 90%. Bis(2-ethylehexyl) phthalate, a chemical used in plastics, was removed by the AWTS system up 37% to 90%. The average concentration in cruise ship AWTS effluent was 6.66 ug/l (+/- .721) (2 detects out of 71 samples). Chloroform was removed by the AWTS up to 67%. The average concentration in cruise ship AWTS effluent was 3.74 ug/l (+/- .351) (27 detects out of 71 samples). Up to 51% or diethlyphthalate was removed by the AWTS system. The average concentration in cruise ship AWTS effluent was 8.57 ug/l (+/- 1.06) (7 detects out of 71 samples). The average concentration of di-n-butylphthalate in AWTS effluent was 8.32 ug/l (+/- 1.07) (8 detects out of 71 samples). The average concentration of phenol in cruise ship AWTS effluent was 20.7 ug/l (+/- 3.00) (25 detects out of 71 samples). The average concentration of toluene in cruise ship AWTS effluent was 3.44 ug/l (+/- .346) (10 detects out of 71 samples). 44 to 97% of tetrachlorethlyene was removed by AWTS. The average concentration of tetrachlorethylene in cruise ship AWTS effluent was 5.59 ug/l (+/- 1.05) (10 detects out of 71 samples).[103]

[102] *Id.* at 2-18.
[103] *Id.*